

INFOBLOX DNS CACHE ACCELERATION

Elevate and future-proof broadband network performance

In the fast-paced telecom landscape, DNS is essential for connecting users to various Internet services. Without it, navigating the web would be cumbersome, requiring the memorization of complex IP addresses. DNS caching is a pivotal mechanism for enhancing network performance, streamlining resource allocation, and elevating user satisfaction. Its role becomes increasingly crucial amidst the emergence of technologies such as 5G, the transition of telecom infrastructure to public clouds, the expansion of edge computing, and the prevalence of advanced broadband and encrypted DNS. By storing DNS query results locally, DNS caching accelerates the resolution of subsequent requests for the same domain name, reducing network traffic and bolstering performance, reliability, and security for telecom services. In this solution note, we delve into why operators must carefully consider DNS caching and how it can help address the challenges inherent in today's telecommunications landscape.

THE IMPORTANCE OF DNS CACHING IN MODERN TELECOMMUNICATIONS NETWORKS

DNS caching plays a crucial role in enhancing network performance by minimizing latency and conserving bandwidth. By storing previously resolved DNS queries locally, it eliminates the need for repeated queries to authoritative or recursive DNS servers, thereby streamlining the user experience and maximizing the efficiency of network resources. In modern telecom environments, low latency is crucial, especially for real-time communication and IoT applications enabled by 5G and advanced broadband. As a result, the importance of DNS caching has heightened.

- **Enhanced Performance and Reduced Latency:** DNS caching offers enhanced performance and reduced latency by storing previously resolved DNS queries locally, thus minimizing the need for repeated DNS lookups. This is particularly crucial in modern operators, where low latency is essential, especially in applications like real-time communication and IoT deployments facilitated by 5G networks. DNS caching can effectively decrease the latency and bandwidth of DNS queries and responses by avoiding unnecessary round trips to authoritative or recursive DNS servers. This improvement enhances the user experience and satisfaction and optimizes the efficiency and utilization of network resources.
- **Efficient Resource Utilization:** Telecom operators manage vast networks comprising numerous interconnected devices and services. Efficient resource allocation is crucial to meet the demands of diverse applications while maximizing infrastructure utilization. DNS caching plays a pivotal role by reducing the load on DNS servers, alleviating network congestion, and conserving bandwidth.

KEY FEATURES

Efficient DNS Caching:

Boosts DNS service performance and reliability by storing DNS responses locally, cutting latency, bandwidth usage, and network traffic.

Ultra-Low DNS Latency:

Sub-millisecond response and advanced threat protection maintains a low latency and a secure subscriber experience.

Flexible and Scalable DNS Caching from Core to Edge to Cloud:

Adaptable to diverse deployment scenarios and operator needs and can be easily deployed as a subscription add-on to both virtual and physical Trinzic appliances—including public cloud platforms.

Become More Responsive to Changing Subscriber Demands:

Service provider licensing and our flexible, distributed approach enables rapid upgrades via Infoblox Grid—enabling a more flexible approach to changing architecture and network architecture and subscriber demands.

- **Cache Management:** Cache consistency and size are crucial considerations in DNS caching. Stale or outdated DNS data poses a risk when cached records aren't promptly updated or invalidated with changes to authoritative DNS data. This inconsistency can lead to incorrect resolution, impacting the functionality and performance of telecom services. Additionally, the size of the cache can consume substantial memory and storage space, necessitating a balance between cache hit rates and resource consumption. An optimal cache eviction policy is essential to effectively managing the benefits and costs associated with DNS caching.
- **Security and Encryption:** Security and Encryption Reinforcement: DNS caching reinforces security by safeguarding against malicious or erroneous DNS responses from compromised or misconfigured servers, thus enhancing the integrity of DNS data. This proactive measure shields operators and their customers from DNS-based attacks like spoofing, hijacking, or poisoning, fortifying the overall security posture of the infrastructure. However, while DNS caching bolsters performance, it also raises security concerns, especially with the rise of encrypted DNS protocols like DNS over HTTPS (DoH) and DNS over TLS (DoT). Although encrypted DNS enhances privacy and addresses certain security risks, it poses challenges for traditional caching infrastructures, which cannot inspect encrypted DNS traffic for caching. Operators need advanced caching solutions capable of seamlessly handling encrypted DNS traffic while upholding security and privacy standards.

NETWORK OPERATOR CHALLENGES

Operator networks are increasingly transitioning to cloud-based environments, introducing complexities necessitating new network designs and security protocols. Tomorrow's operator networks must be highly resilient, facilitating fast, low-latency performance and robust protection against cyber threats.

- **Edge Forward Transformation:** However, as operators embrace edge computing to bring resources closer to end-users, the traditional centralized approach to caching faces challenges. Deploying distributed caching mechanisms at the edge becomes imperative to ensure optimal performance and minimize latency.
- **Increasingly Dynamic Networks:** Nevertheless, the dynamic nature of telecom networks, exacerbated by the rapid deployment of technologies such as 5G and a proliferation of IoT devices, introduces complexities that traditional caching strategies may struggle to address. Operators must employ adaptive caching mechanisms capable of dynamically adjusting to changing network conditions and traffic patterns.
- **Navigating the Shift to Public Clouds:** Operators increasingly embrace cloud computing to augment their infrastructure scalability, agility, and cost-effectiveness. However, this shift to public clouds necessitates rethinking DNS caching strategies to accommodate the distributed nature of cloud-based deployments. Traditional centralized caching architectures may prove inadequate in cloud environments characterized by dynamic resource provisioning and geographically dispersed data centers. Operators must leverage cloud-native caching solutions that seamlessly integrate with cloud platforms, ensuring optimal performance and scalability while minimizing operational overhead.

Supports Encrypted DNS:

The system supports encrypted DNS protocols, including DoH and DoT for secure endpoint communications, and utilizes Type 64 and 65 DNS records to optimize HTTPS connections—reducing latency and enhancing user privacy and security.

Reduces Cost of Ownership:

Do more with the same headcount by eliminating repetitive and labor-intensive server administrative tasks and eliminating generic server support costs.

- **Addressing Growing Traffic Demands:** The proliferation of advanced broadband technologies, including fiber-optic networks and gigabit-speed connections, poses unique challenges and opportunities for DNS caching in operators. While these technologies enable faster data transmission and support bandwidth-intensive applications, they also place greater demands on caching infrastructure to maintain pace with escalating network speeds and capacities. Additionally, the growing trend towards hybrid and software-defined networking (SDN) architectures necessitates adaptable caching mechanisms that dynamically optimize cache management and content delivery across diverse network environments.

THE OPPORTUNITY

Operator networks are expanding – both within their existing telco network footprint and increasingly into the edge and public cloud. This transition and accompanying industry impact creates numerous challenges for network operators. A perpetual priority is ensuring high performance while managing the challenge of cost-effectiveness and scalability in delivering network services at wire speeds anywhere on the network across various physical and virtual form factors. With increasing resource deployments at the network edge and on different cloud platforms, security teams face the difficult task of managing numerous pods, virtual machines (VMs), and containers across physical, virtual, and cloud environments.

Networking and Security Priorities

- **Ultra-low DNS latency.** Operators now need to accommodate real-time applications that require fast and smooth communication between the users and the servers. To achieve this, network operators need to deploy DNS servers closer to the users and optimize the DNS query process.
- **Achieving High Throughput.** Operators face the challenge of delivering high-performance network services anywhere in a cost-effective and scalable way. Wire-line speed, the peak data transfer rate a physical wire or cable can handle, is crucial for virtualized network functions in telecommunications. Maximizing this speed minimizes latency, boosts performance, and unlocks opportunities for bandwidth-intensive, low-latency applications and services.
- **Low-Overhead DNS Logging:** DNS is critical to any CSP, and operators must have a clear understanding of how their DNS functions to ensure the reliability, security, and performance of telco networks while aiding in regulatory compliance and optimizing resource utilization. However, using methods like packet capture and syslog is highly inefficient and complex, especially in today's increasingly distributed operator networks.
- **Auto-scaling DDI.** Operators often rely on manual processes or managing their DNS caching. For mobile providers, private and public network slicing allows network operators to create multiple virtual networks on the same physical infrastructure, each with different characteristics and requirements. To support this, network operators need to have flexible and scalable DDI services that can automatically adapt to the changing demands.
- **Delivering DDI Services at the Edge.** This is beneficial as operators increasingly leverage public clouds to support deploying and managing 5G networks and multi-access edge computing (MEC) closer to subscribers and devices. To enable this, network operators need to have distributed DDI services that can support the dynamic and heterogeneous nature of the edge network.
- **Eradicate Manual Intervention.** In modern telecom networks, manual DNS caching management can be inefficient, unreliable, and insecure. This can be inefficient and resource-intensive, demanding significant memory, storage, and bandwidth to maintain DNS records. This manual intervention also introduces redundancy and inconsistency across cache servers, leading to potential data disparities – potentially slowing down query responses, increasing latency, and exposing networks to vulnerabilities and attacks due to possible server failures or compromises.
- **Lower Costs and Increase Scalability.** Inefficient DNS caching can negatively impact the cost and scalability of telecom networks. If the cached records are outdated or inaccurate, the DNS resolver may need to query other servers repeatedly, increasing the latency and bandwidth consumption for the clients. Also, if DNS caching is not managed correctly, DNS resolvers may need to refresh records more frequently, generating more network traffic and increasing the load on the authoritative name servers.

THE SOLUTION: INFOBLOX DNS CACHE ACCELERATION

Infoblox, an industry leader in networking and security services, offers best-of-breed Core Network Services with comprehensive security to provide a single end-to-end solution for centralized management of secure, distributed telecommunications networks. These solutions cater to CSP environments needing scalable edge deployments. Infoblox offers carrier-grade choices, including orchestrated Virtualized Network Function (VNF) and cloud-native solutions for public clouds. Infoblox solutions aid broadband service providers in delivering high-performance, secure, and scalable DNS services, addressing the challenges and complexities of modern operators.

Infoblox DNS Cache Acceleration (DCA) boosts DNS service performance and reliability by storing DNS responses locally, cutting latency, bandwidth usage, and network traffic. It speeds up DNS caching by storing query results in memory, reducing latency, and easing the load on authoritative DNS servers and the network. DCA handles high query volumes, delivers fast responses, enhances user experience, and cuts bandwidth and operational expenses.

While non-stop DNS is critical for your subscribers, the cost of maintaining it is paramount for you. Infoblox appliances for high-performance DNS caching reduce the cost of operating, maintaining, and upgrading your DNS infrastructure. Infoblox appliances remove the security, reliability, and administrative issues associated with the generic server and OS management—the Infoblox Grid™ helps you automate and manage appliance upgrades and patches from a single point—no more server-by-server scripting and patching. Through centralized management, network operators can quickly instantiate, implement and auto-scale network services and manage those services more efficiently through a unified family of devices.

Features That Matter:

- Designed to handle the “perfect storm” of future mobile and edge-based applications that require ultra-low latency – supporting DNS query rates up to five million queries per second and ultra-low latency of 50 microseconds on the average.
- Supports DNSTap, a log format for DNS software that allows operators to monitor and analyze DNS infrastructure performance and security by providing detailed data on queries and responses, including latency, error rates, and source/destination addresses. This data aids in troubleshooting, performance optimization, anomaly detection, and generating reports. DNSTap simplifies logging by eliminating the need for packet capture or additional software on DNS servers.
- Supports encrypted DNS protocols, including DNS over HTTPS (DoH) and DNS over TLS (DoT), enabling operators to encrypt last-mile DNS communications between their endpoints and DNS servers regardless of which protocol the endpoint supports.
- Supports Type 64 (HTTPS Binding) and Type 65 (SVCB) DNS Resource Records, helping reduce the latency and bandwidth consumption of HTTPS connections, as well as enhance the privacy and security of users. By using Type 64 and Type 65 records, clients can avoid unnecessary DNS queries, TCP connections, and TLS handshakes and instead connect directly to the optimal server with the desired protocol and encryption settings.
- Provides wire speeds without the overhead and boosts network performance anywhere operators require, even at the edge and on the public cloud, by leveraging technologies such as DPDK and SR-IOV that can optimize packet processing and bypass the overhead of the operating system kernel. These features enable operators to improve network performance, reduce latency, increase throughput, and enhance security.
- Expands DNS efficiency by supporting TCP and UDP protocols to handle different types of DNS queries and scenarios to support larger response sizes and greater network compatibility. It also allows for increased flexibility in working with Authoritative and Recursive DNS, enabling operators to streamline their networks for improved efficiency.
- In conjunction with the Infoblox Grid, DNS Cache Acceleration improves reliability with automated high availability (HA) and disaster recovery (DR). Improves reliability with automated HA/DR— reduces downtime by eliminating slow, manual, error-prone upgrade processes. It supports HA pairing of DNS Cache Acceleration instances, which allows automatic failover and synchronization of DNS cache data between the active and passive nodes. Infoblox Grid monitoring and reporting allow tracking of the performance and status of DNS cache acceleration instances and services.

THE INFOBLOX ADVANTAGE—ULTRA-LOW LATENCY

DNS caching is used to deploy large-scale advanced broadband and 5G networks and services. Infoblox DNS Cache Acceleration offers ultra-low latency of 50 microseconds on average, scaling to millions of devices with ultra-high five-9s reliability. By combining highly optimized DNS caching software with software-based packet processing acceleration technologies like Data Plane Development Kit (DPDK), Infoblox enables service providers to build highly scalable DNS caching solutions with accelerated packet processing performance and throughput that meet the rapidly growing demands from their customers.

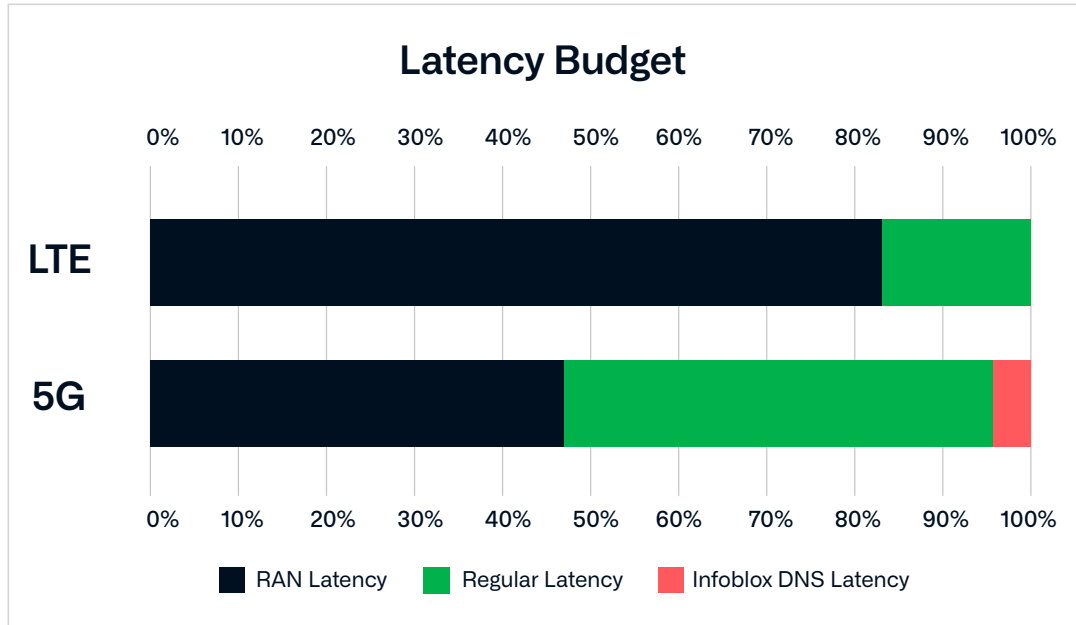


Figure 1: Infoblox DNS Cache Acceleration provides enhanced network performance and unprecedented low levels of DNS query latency.

UNLEASH DNS—FROM CORE TO CLOUD

Infoblox DNS Cache Acceleration is designed for broadband environments requiring scalable edge and cloud deployments. It is available in multiple carrier-grade options, including orchestrated Virtualized Network Function (VNF) and cloud-native solutions. Deploy where you want and scale when you need it. Infoblox offers flexibility and scalability tailored to different broadband providers' operations. Efficient DNS caching is ensured, even at the far edge and on the public cloud. And with centralized management, network operators can swiftly instantiate, implement, and auto-scale network services, efficiently managing them across a unified family of devices.

- **Infoblox Trinzie Flex:** a scalable virtual platform based on the resources allocated to the virtual machine. The Infoblox Network Identity Operating System (NIOS) automatically detects the virtual machine's capacity and scales it to the appropriate platform. Additionally, Trinzie Flex is covered under the Service Provider License Agreement Program (SPLA).
- **Available on Physical, Virtual and Cloud Platforms:** Software DNS Cache Acceleration is a software subscription add-on to a variety of [Trinzie hardware and software appliances](#), enabling services to run on a common model and supporting on-prem, private and public cloud environments.

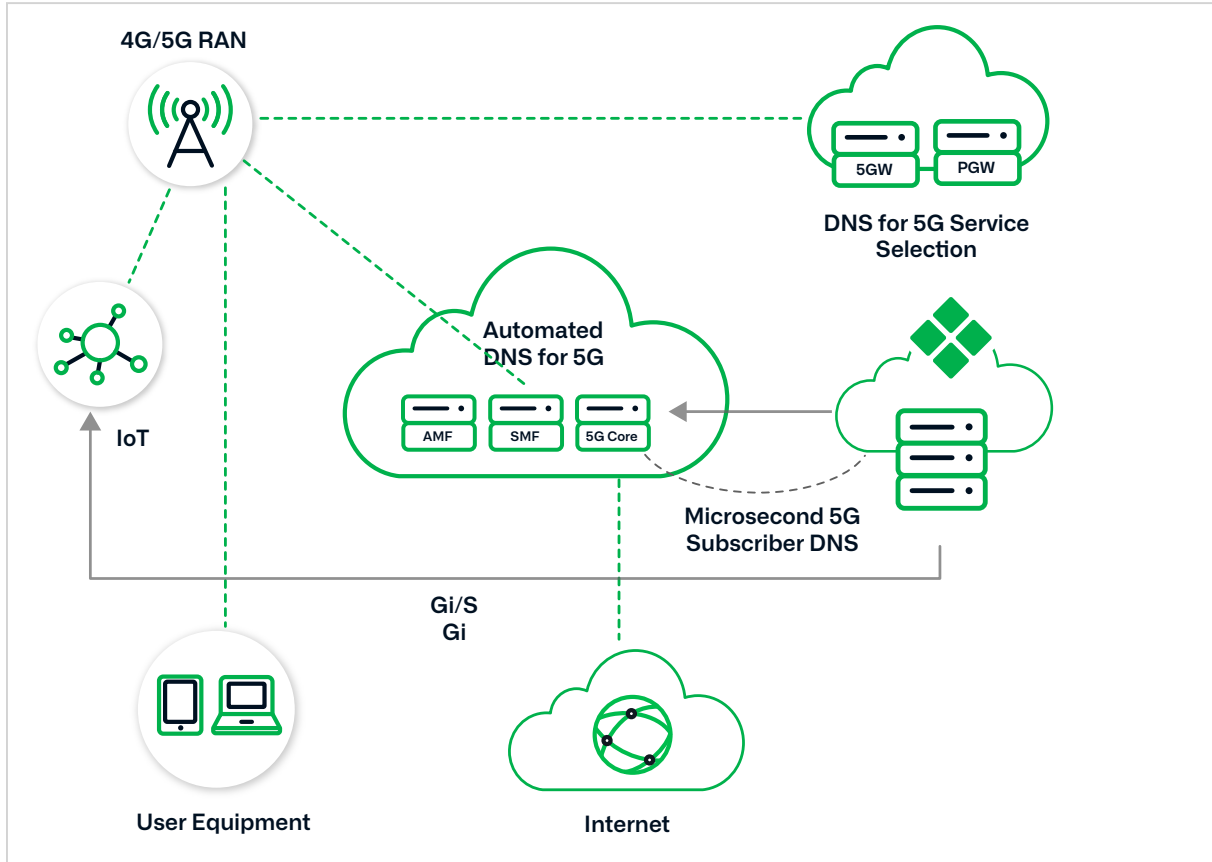


Figure 2: With Infoblox DNS Cache Acceleration, operators gain ultra-fast performance for 5G, advanced broadband and edge-based applications.

NETWORKING AND SECURITY: A POWERFUL COMBINATION

Infoblox unites networking and security by offering two complementary solutions that help broadband operators boost the performance and security of DNS resolution in their networks. In addition to DNS Cache Acceleration, Infoblox also offers a purpose-built, DNS-specific security solution that detects and thwarts attacks at the root, preventing spoofing and hijacking and enhancing performance and resilience.

Infoblox Advanced DNS Protection (ADP) seamlessly integrates with existing operator DNS setups. ADP's intelligent detection and mitigation strategies, powered by adaptive threat intelligence, can effectively distinguish and block malicious queries – from volumetric to DNS hijacking – without the need for excessive infrastructure or frequent security updates.

Better Together

By combining Infoblox DNS Cache Acceleration with Advanced DNS Protection, broadband operators gain a dual advantage. From network core to network edge, they can expect enhanced performance through efficient DNS response caching and robust security against diverse DNS threats. This synergy ensures a fast, reliable, secure network experience, instilling confidence in the operators about the improvements they can expect in their network operations.

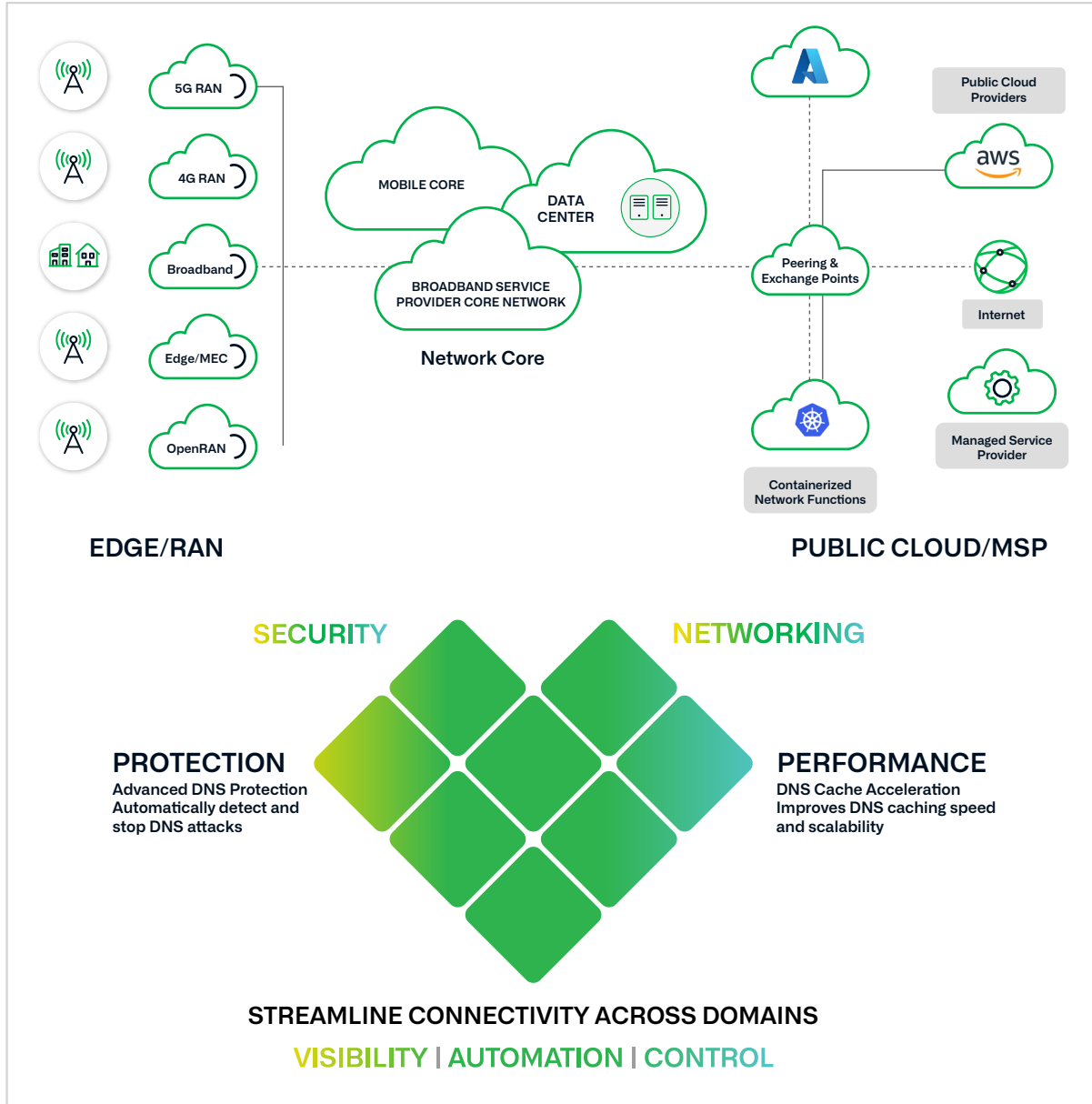


Figure 3: Infoblox DNS Cache Acceleration, combined with Advanced DNS Protection, provides enhanced performance and robust security against diverse DNS threats.



Infoblox unites networking and security to deliver unmatched performance and protection. Trusted by Fortune 100 companies and emerging innovators, we provide real-time visibility and control over who and what connects to your network, so your organization runs faster and stops threats earlier.

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